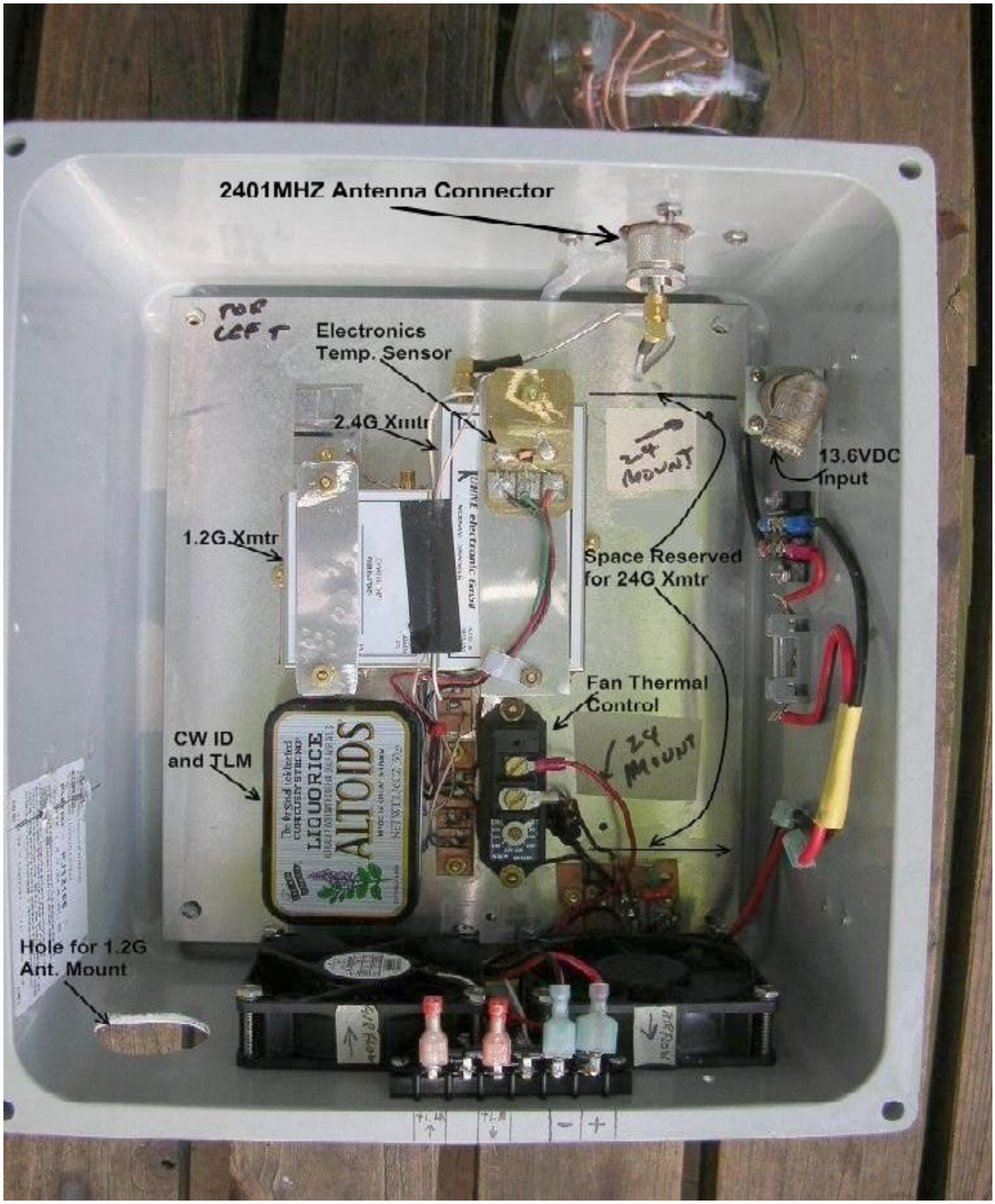
Building a Beacon for 2401 Mhz

By John Jamient W3HMS and Charlie Heisler, K3VDB

Due to not having a HEO Satellite for quite some time to use as a signal source,
we thought a 24/7 Beacon might be useful to Folks around S-Central PA. etc



Overview

The microwave community makes extensive use of beacons for equipment and propagation checking on all bands from 6m-24 Ghz so why not do the same for satellite users? Yes, that is what we said so we set about to build a dual beacon for 1296.064 Mhz horizontal polarization and 2401 Mhz circular polarization both in the same box.

The “WE” in this case is Fred Lowe, W3MMV, Joe Lockbaum, WA3PTV, John Jamient, W3HMS and Charlie Heisler, K3VDB. We defined the tasks to be done and the purchases to be made then shared same among our group. I (W3HMS) have operated a Kuhne Electronics beacon on 10 Ghz for about 6 years now and was so very pleased with the dependability of their products which is consistent with their other products that I use for contesting on VHF, UHF and Microwaves.

Technical Summary

The heart of the two beacons is the Kuhne Electronics of Germany “Bakensenders” for each band. Each was ordered with the frequency specified. Each uses F1 FSK keying via a classic “make and brake” Keyer which promotes better short term stability. The Fequency will change a few KHzs over time as the crystal ages. W3MMV volunteered to fabricate the horizontally polarized Alfred Slot antenna for 23 cm from “scratch” as did K3VDB for the 13 cm circularly polarized Lindenblad antenna. The slot antenna gain is about 4 db and the Lindenblad about 3 db and both antennas are housed in radomes. The 10 Ghz experience told us that we wanted to use a WW2R keyer with telemetry so we could remotely monitor the health of each beacon which is keyed by the same keyer. We use two blowers both for air flow and dependability turned on and off by a thermostat set to about 80 degrees. All is mounted in a waterproof box designed for the electrical trade to house both beacons. A single coax cable feeds 13 VDC to the beacons. The 23 cm beacon has an output power of 1.5 watts and the 2401 beacon, 1 W

Telemetry. (TLM)

TLM has 4 positions of information. It was designed and built and the PIC programmed by Doug Robinson, G4FRE/WW2R in Texas. All the details are available on his Web site which I found with "WW2R" in Google. The keyer with telemetry is called an "Intelligent Keyer" and it is viewable on his site under this title with schematic. Doug programs your desired message at purchase time. It is possible to send any sensor value which can be expressed in the range 0-5 VDC.

Beacon Message.

We decided we wanted to send ….W3HZU/B W3HZU/B FN10PA FN10PA QSL to W3HMS@aol.com (then the telemetry in 4 groups of three numbers like) 056049009032….then recycle.

a. **DC Bus Voltage**. The DC voltage on the beacon bus is calculated by a formula a bit too complex to use in your head but easy to define in an EXCEL spreadsheet for common values. Let's say you copy the first group number 056, that = 12.60 VDC at the beacon input.

b. **Thermometer.** The second set of 3 numbers is the thermometer mounted on the beacon xmtr cover. One half of the temperature in F is sent in CW. As a example, 049 is sent so 049 x 2=98F. The thermometer is the reasonably priced LM34DZ.

C. **Vent Fans**. If the 2 vent fans are ON, the numbers are more like 231 than 000, as the latter indicates the fans are off. The fans cycle on and off about every 6 minutes at a outside temp of 70 degrees F.

D. **Outside Temperature**. The temperature outside the beacon is sent as defined above for beacon temperature.

Performance

The beacon entered service at a temporary site on 6 June 2007. Initial tests from the W3MMV QTH confirmed good operation but the signal was weak at any real distance. K3VDB was able to obtain temporary permission to mount the beacons at a height of about 1130 FAS on a tower in Red Lion, PA, grid square FM19qv.

The beacon signs W3HZU and FN10PA as that is the ultimate destination on their 200 ft tower at about the 150 foot level. We have had excellent reports on the 23 cm beacon out to about 100 miles. The 2401 Mhz beacon has been heard at about 75 miles. The Weak Signal Group has asked why

not 2304 Mhz and we have explained the needs of satellite operators at 2401 Mhz. An EXCEL spreadsheet has been developed by K3VDB to record telemetry data in a scientific manner, and is available on request.

Cost. These beacons are quality instruments and as such are not cheap, HI! We will be happy to discuss this aspect with serious prospective builders.

Photos. We have included photos of the complete beacon package with the two antennas.

Signal reports are welcomed and for further information and technical details, please contact Charlie Heisler, K3VDB at EMAIL k3vdb@amsat.org or John Jamient, W3HMS at w3hms@aol.com.

Factoids of the W3HMS 1.2Gig and 2.4Gig Beacons

First on the air June-6-2007
Beacons were purchased from Kuhne Electronics (DB6NT) and are collocated in FN10pa Just East of York PA. on the W3HZU Keystone VHF Club's Tower

Freq. of the 1.2G Beacon=1296.079 MHZ
Freq. of the 2.4G Beacon=2401.00 MHZ

Voltage at the Power Supply =13.79V DC
Voltage at Beacon=13.67V DC @ 1.38A

Note: (~) Indicates About, or to the best of our knowledge
1.2G Antenna is an Alford Slot, ~4db Gain, Horizontal in PVC Radome
2.4G Antenna is a Lindenblad, ~3db Gain, R/Hand Circular in Glass Radome

The 1.2G Beacon Output=~1.5W
The 2.4G Beacon Output=~1.0W

Some Temperature Observations;
With an Outside Temp of ~90ºF the Electronics Temp is ~108º W/Fans On.
(At this Temp. the 2.4G Freq. is ~2401.00MHZ)
At ~70º the Fans Cycle On and OFF about every 6 Minutes, the

Electronics
Temp lowers about 4-5º when Fans come on.
(At this Temp. the 2.4G Freq. is ~2400.998MHZ)

The AFSK CW ID and Telemetry (TLM) message is:
W3HZU/B (Two Times) FN10pa (Two Times) QSL to W3HMS@aol.com
XXXXXXXXXXXX Then ~ 14 Seconds of Key down (Then it repeats)
The eXes are Beacon TLM numbers reporting Beacon Health. They are to be read in groups of 3. The first group indicates P/S Volts, To decode the numbers you would Divide it by 51.2 then Multiply by 11.283. The second group is the electronics Temp, multiply this number by 2. The 3rd group indicates fans on or off, Any number around 250 indicates Fans On, below 250 Fans Off. The 4th group is outside temp, multiply by 2 to get outside trmp.

An MS Excel Spreadsheet is available for decoding TLM.

K3VDB August 3, 2007

Figure 1 2401MHZ Lindenblad Antenna

Figure 2 1296MHZ Alfred Slot Antenna

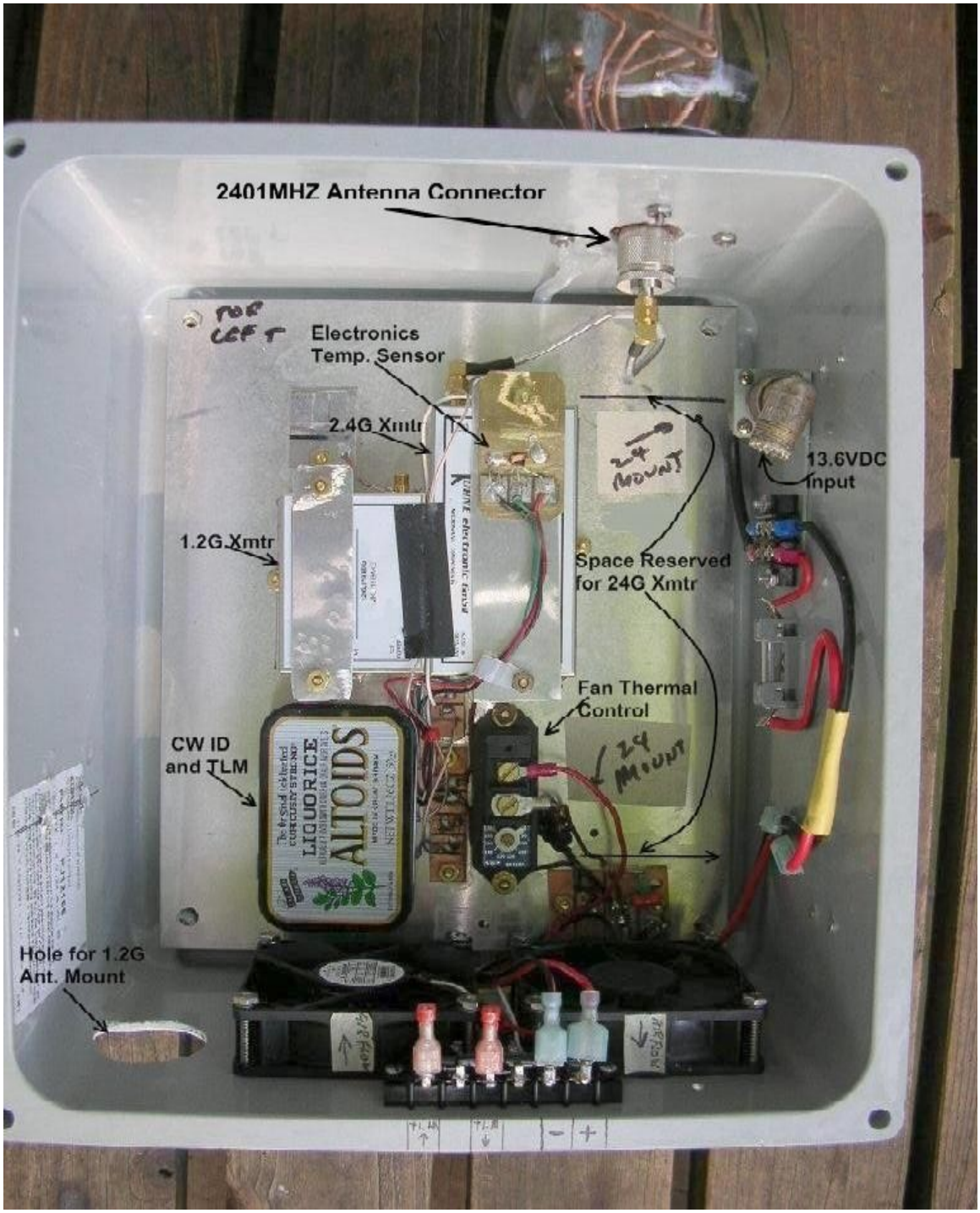


Figure 3 Inside The Box

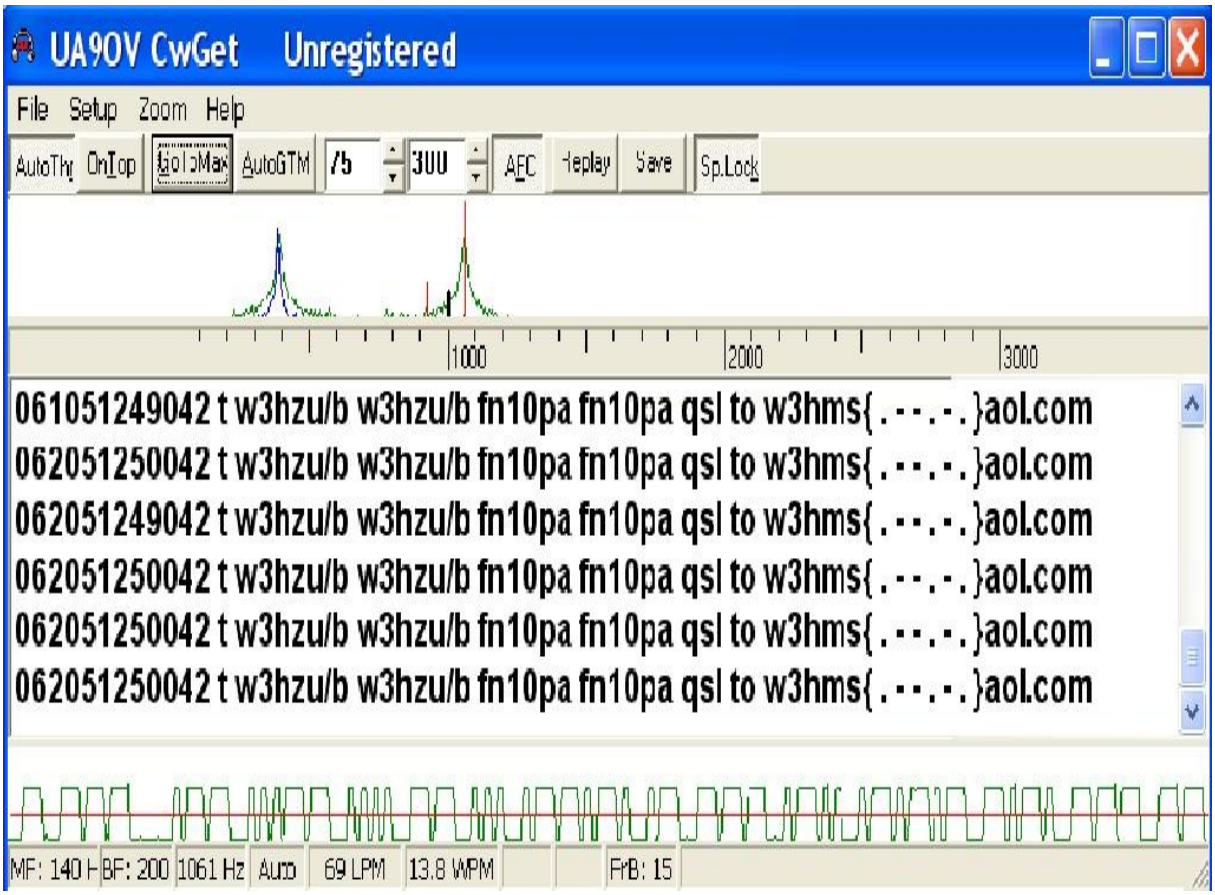

UA9OV CwGet Unregistered
File Setup Zoom Help
AutoTh OnTop AutoMax AutoGTM 75 300 AFC Replay Save Sp.Lock
1000
2000
3000
061051249042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
062051250042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
062051249042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
062051250042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
062051250042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
062051250042 t w3hzu/b w3hzu/b fn10pa fn10pa qsl to w3hms{.--.-.}aol.com
MF: 140 H BF: 200 1061 Hz Auto 69 LPM 13.8 WPM FrB: 15

Figure 4 Beacon ID and TLM

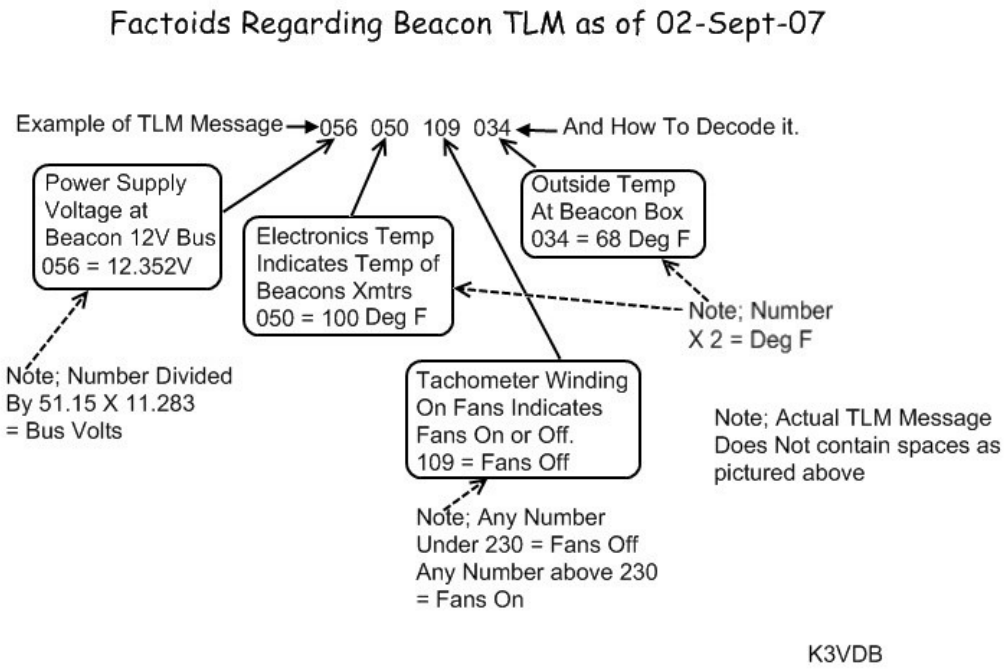
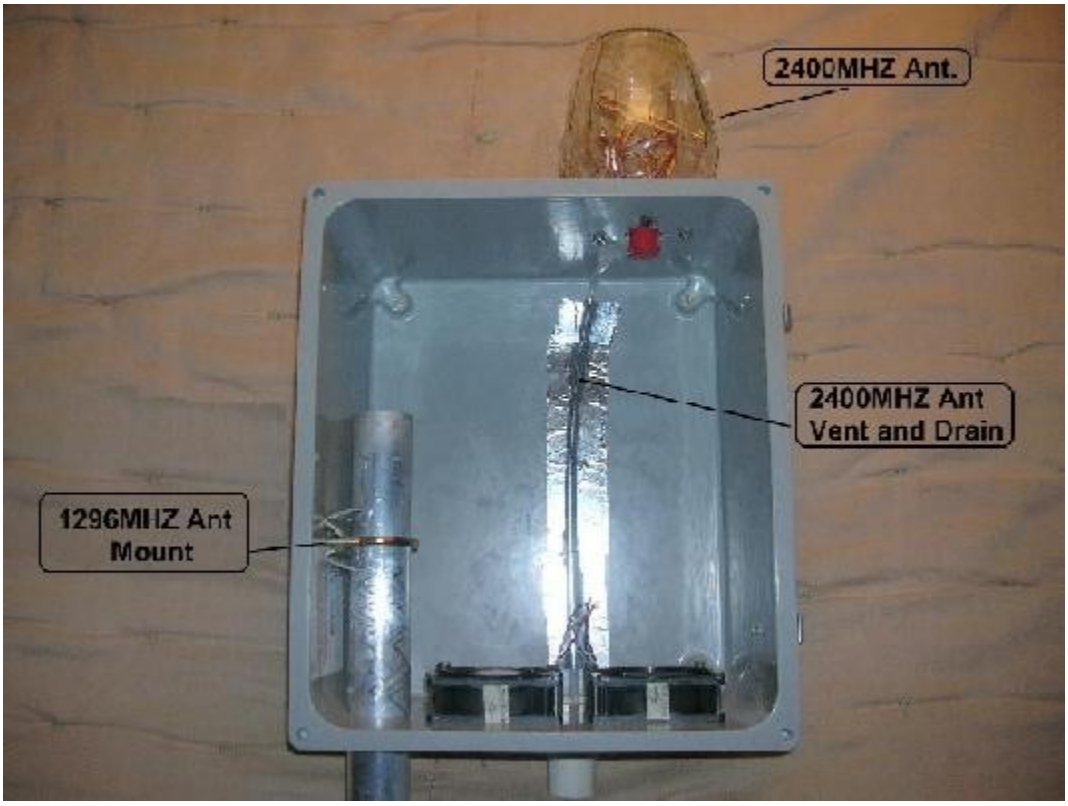
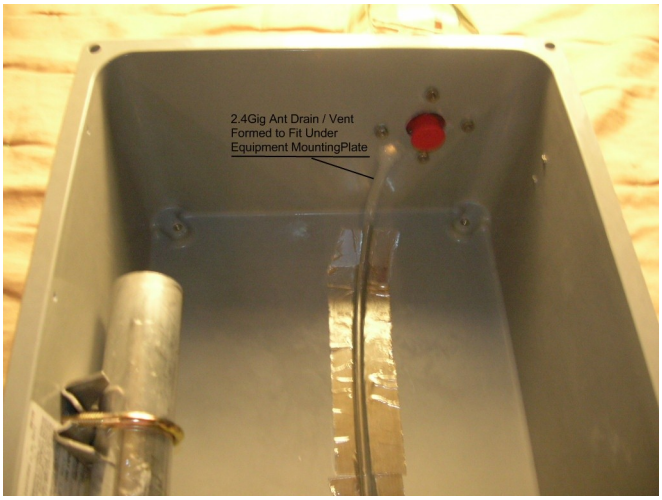

Factoids Regarding Beacon TLM as of 02-Sept-07
Example of TLM Message
056 050 109 034
And How To Decode it.
Power Supply Voltage at Beacon 12V Bus 056 = 12.352V
Electronics Temp Indicates Temp of Beacons Xmtrs 050 = 100 Deg F
Outside Temp At Beacon Box 034 = 68 Deg F
Note; Number X 2 = Deg F
Note; Number Divided By 51.15 X 11.283 = Bus Volts
Tachometer Winding On Fans Indicates Fans On or Off. 109 = Fans Off
Note; Actual TLM Message Does Not contain spaces as pictured above
Note; Any Number Under 230 = Fans Off Any Number above 230 = Fans On
K3VDB

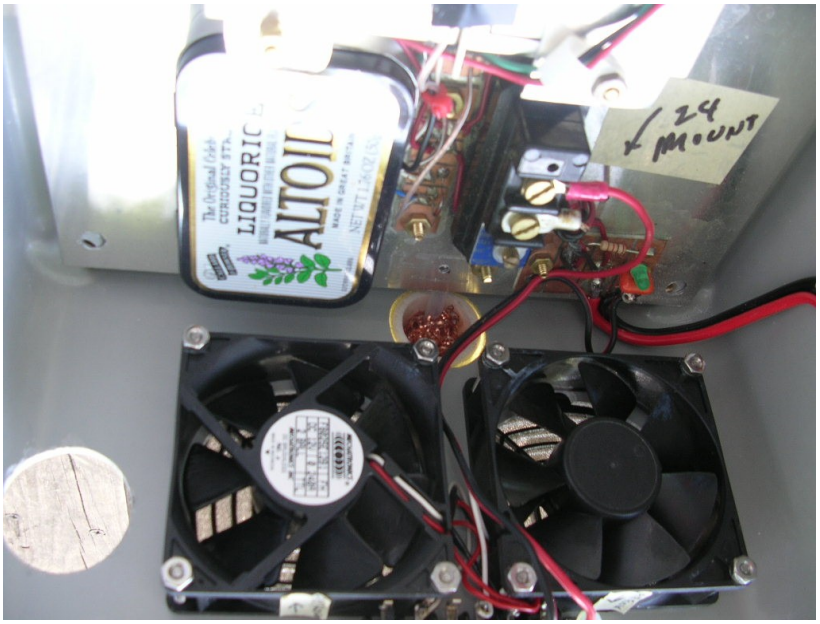
Figure 5 Explanation Of TLM Numbers

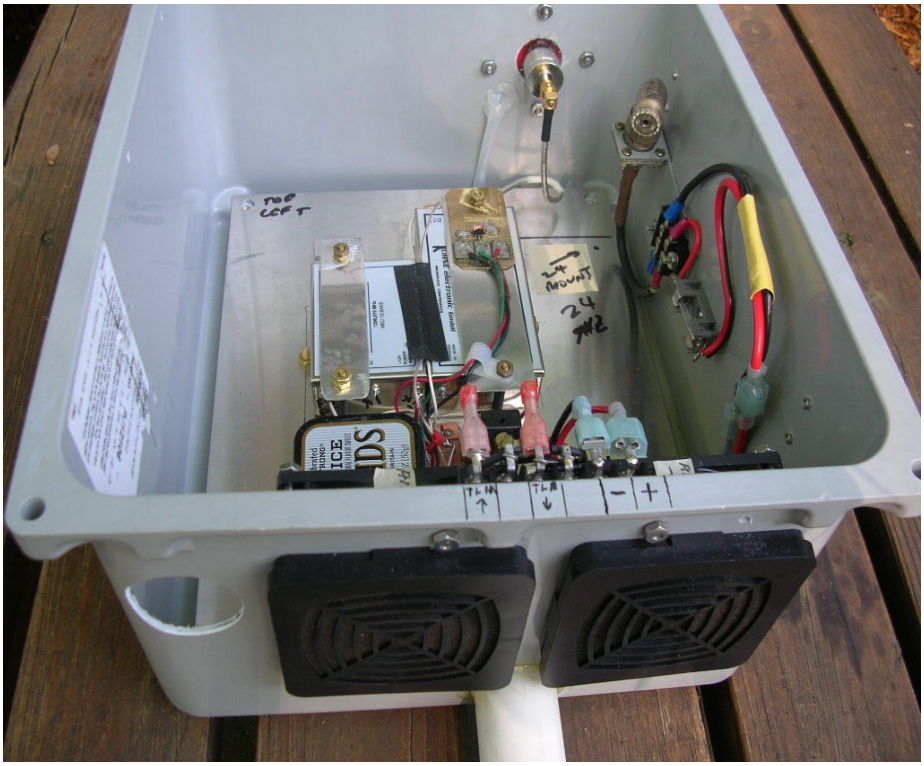
	August				August	
	08/2007	1400 Hrs			23/2007	9:00 AM
TLM Channel #1				TLM Channel #1		
CW Count	DC Bus Volts			CW Count	DC Bus Volts	
54	11.91167	VDC		56	12.35284	VDC
TLM Channel #2				TLM Channel #2		
CW Count	Electronics Temp.			CW Count	Electronics Temp.	
52	104	°FNormal		52	104	°FNormal
TLM Channel # 3				TLM Channel # 3		
CW Count	Fans On / Off			CW Count	Fans On / Off	
231	4.516129	Fan ON		15	0.293255	Fan OFF
TLM Channel #4				TLM Channel #4		
CW Count	Out Side Temp.			CW Count	Out Side Temp.	
40	80	°F		32	64	°F

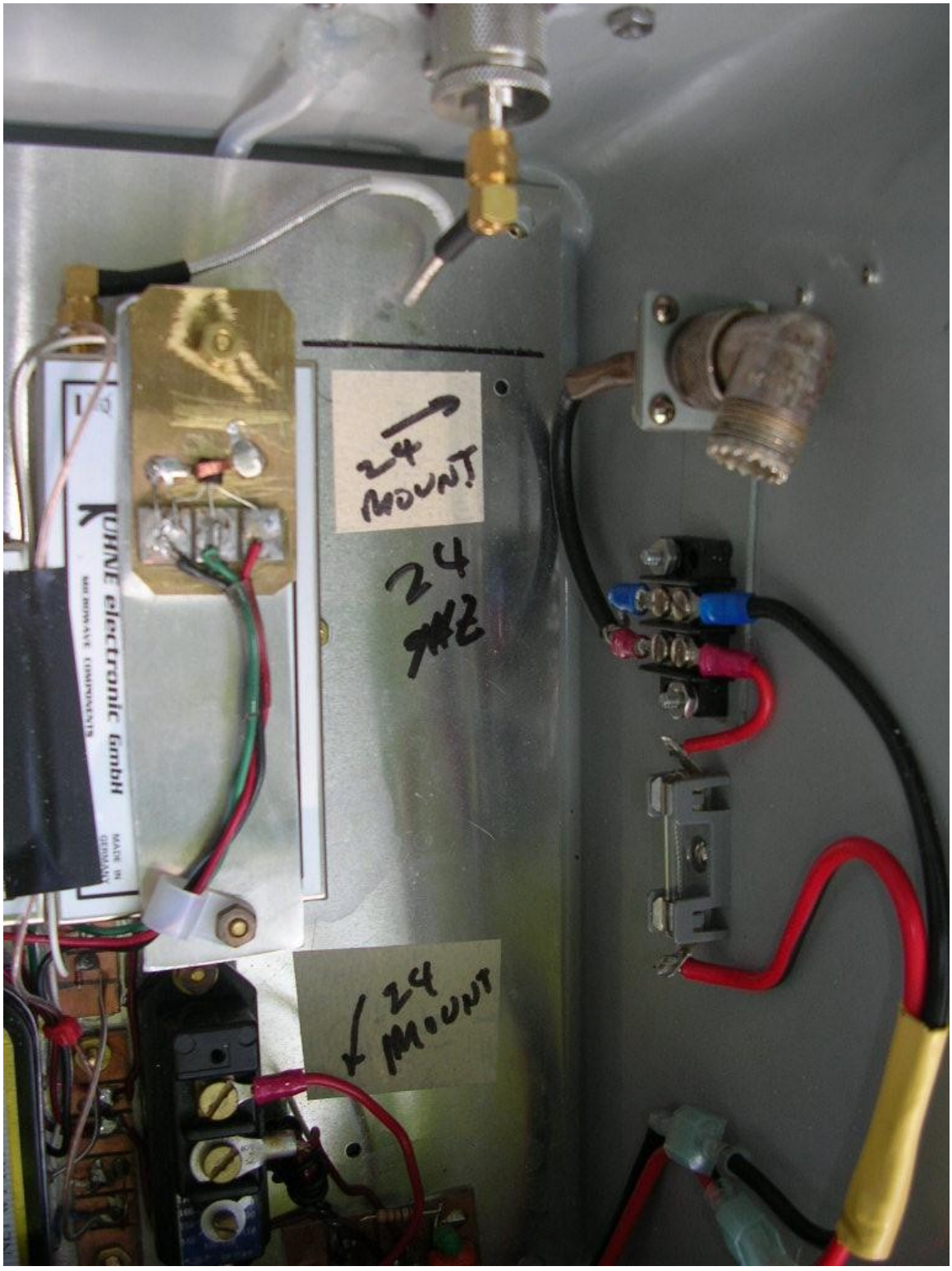
Figure 6 Spreadsheet To Display and Track TLM


2400MHZ Ant.
2400MHZ Ant
Vent and Drain
1296MHZ Ant
Mount


2.4Gig Ant Drain / Vent
Formed to Fit Under
Equipment MountingPlate


LIQUORICE
ALTOII
24 MOUNT


TOP LOFT
24 MOUNT
KWE Elektronik GmbH
ICE
DS
TL HR
TL A
-
+


24 MOUNT
24 MHz
+ 24 MOUNT
KUHNE electronic GmbH

Temp Location at W3MMV's

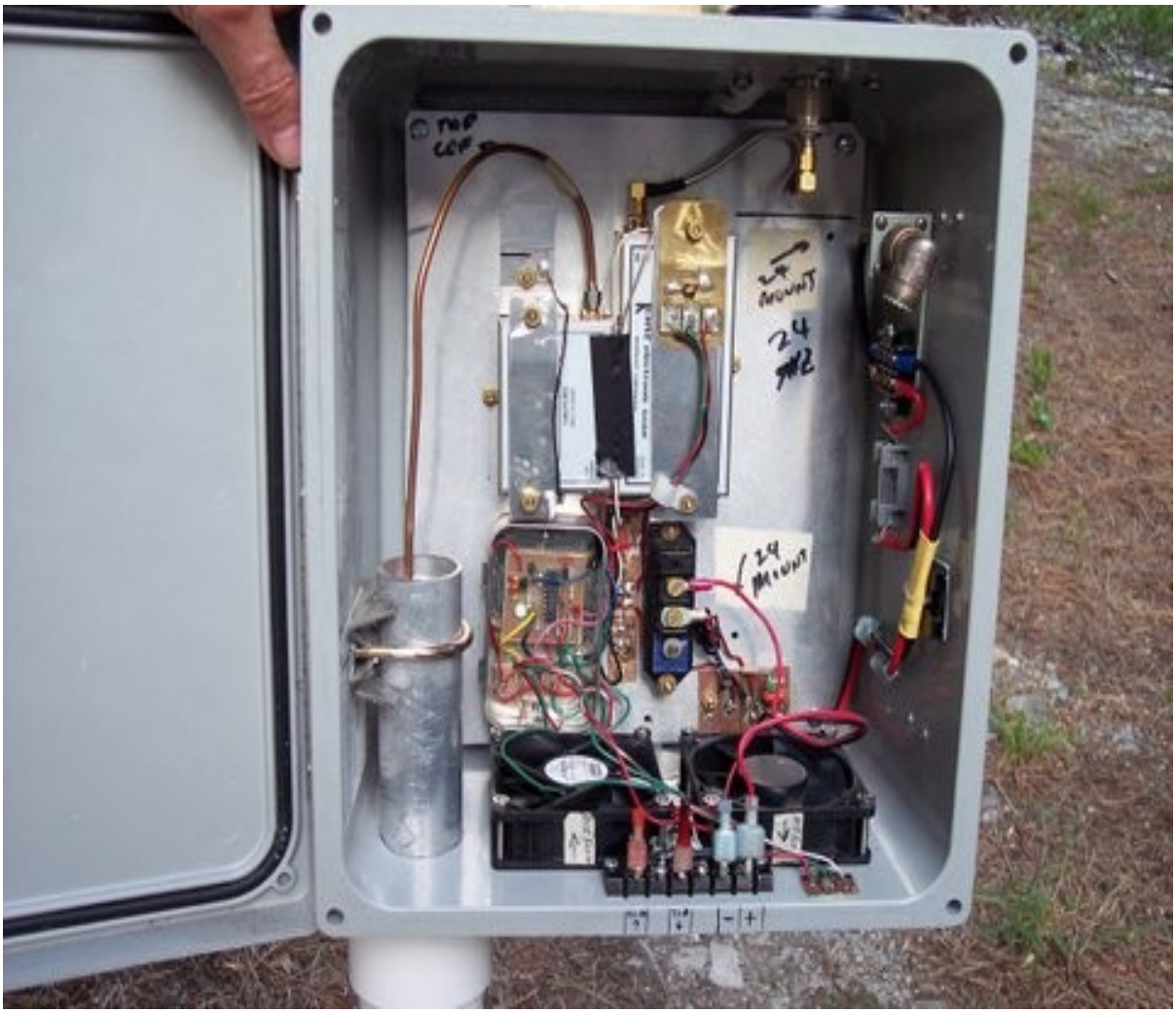

24
24

Figure 7 Box Bottom

The End